Handwriting Recognition & Character Prediction using Neural Networks

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Abstract— Handwriting Analysis or Graphology is a scientific method of producing a personality profile of the writer by examining the characteristic traits by identifying, evaluating the strokes and patterns of the handwriting. Handwriting reveals the true personality including emotional outlay, fears, honesty, defences and many others. Professional handwriting examiners are known as graphologists, they predict the personality of a writer by just examining even a short piece of hand writing. Accuracy of handwriting analysis depends on skills of the graphologists, a skilled graphologists would come at a greater cost and human intervention in handwriting analysis is prone to fatigue, although it's effective. Hence the proposed methodology focuses on developing a tool for behavioral analysis which can predict the personality traits automatically with the aid of a computer without the human intervention. In this paper a method has been proposed to predict the personality of a person from the baseline, the pen pressure and strokes by examining the numbers '0', '1', '2', '3', '4', '5,'6', '7', '8', '9'and the letters 's', 'u', 'd', 'o', 'y', 't', 'b', 'p' through an individual's handwriting. These parameters are the inputs to the Artificial Neural Network which outputs the personality trait of the writer. The performance is measured by examining multiple samples.
Key words: Handwriting Analysis, Graphology, Graphologists, Behavioral Analysis, Characteristic Traits, Artificial Neural Network

I. INTRODUCTION

Handwriting Analysis or Graphology is a scientific method of identifying, evaluating and understanding personality through the strokes and patterns revealed by handwriting. Handwriting can reveal the personality fears of a person like the emotional outlay, honesty, fears.

In this paper, a method has been proposed to predict the personality traits of a person from the features extracted from his handwriting which include baseline, slant, pen pressure. The ANN is fed the baseline, pen pressure, word spacing, letter size, slant and the input letters 's' and 'p' and it predicts the personality of the writer and returns it as the output. We have characterized the above properties of the hand writing into three categories as shown in the image below along with some example of the letters from the English language:

Fig. 1: The Traits of Writer Which Can Be Interpreted From His/Her Writing Style

The evaluation of the baseline and letter slant of the letters are calculated using the polygonalization method, evaluation of the word spacing is done by calculating the margins of the words and the evaluation of the pen pressure utilizes grey-level threshold value and evaluations of the letters 's' and 'p' use template matching technique. We have used Python and its extended libraries for the purpose.

II. PROPOSED METHODOLOGY

Professional handwriting examiners called graphologist often identify the writer with a piece of handwriting. Accuracy of handwriting analysis depends on how skilled The most common feature of handwriting that can serve as scheme to predict personality traits are baseline, size of letters, writing pressure, connecting strokes, spacing between letters, words and lines, starting strokes, end-strokes, word-slant, speed of handwriting, width of margins, and others. In this paper the baseline, the writing pressure, the height, and word spacing of the letters are considered for predicting the personality of the writer [10].

The terms are discussed as:

A. Baseline

Baseline is pre-printed or imaginary line on which letters reside. If the paper is with no pre-printed line, then writer assumes their own baseline according to his/her writing style. Even on the pre-printed page writer is not adhere to the line during the writing. Hence the writing can be as shown in Fig.1. Appropriately each one relates to a specific personality trait of the writer.

Fig. 2: The Baselines Representing Different Personality Traits of the Writer

B. Writing Pressure

The other most important feature in a handwriting is the writing pressure. The amount of pressure exerted on the paper while writing is the depth of feeling, also called emotional intensity. Based on the pen pressure the writer can be classified as light writer, medium writer and heavy writer. Table 1: Shows the corresponding personality traits of the different pen pressures.

Techniques to examine the above discussed properties are:

C. Polygonalization

It is a method of subdividing the plane into polygons. In this technique of polygonalization, a closed polygon is drawn around a single line of scanned handwriting sample and the slope of the polygon is found suing the coordinates of the polygon.

D. Thresholding

The pen pressure can be calculated as a count of the number of foreground pixels in the threshold image. The number of black pixels is indicative of the pen-pressure, thickness of strokes, and the size of writing.

The lower case letters 's' and 'p' can be written in number of different ways and they can predict a lot of information about the writer. Here are the ways in which the letters 's' and 'p' can be written and the characteristics of the persons which can be predicted based on them in the following Figure 3 and Figure 4.
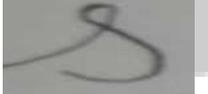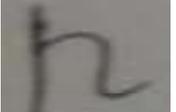
Formation of S	Personality traits	
	starting in curves and a big loop	generosity, sympathy and giving
	with a small loop	Honesty, familiarity, sensitive to ethical principles
	closed with a loop	Adjusts to reality through practical sense
	straight initial stroke	Combative person, little social adjustment. Inopportune
	arched	Cunning, agile, haughtiness and pride covered behind an innocent attitude

Fig. 3: The Scanned Patterns of Letter 'S' Representing Different Traits of the Writer

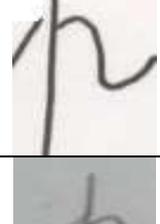| Formation of P	Personality traits	
	No initial stroke	Intelligent and Independent
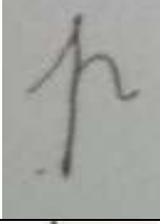
	Angular Stroke	Technical skills, rigorous at work, respect by ethical principles
	Interrupted Initial Stroke	difficulty for adjustment
	With an initial arch	selfish personality
	Very short edge	difficulties in the realization of actions
	Medium Edge	vitality, activity
	Large Edge	Active personality, sportive, action. If it is very long, may show materialism, sensuality, naïve, imaginative.
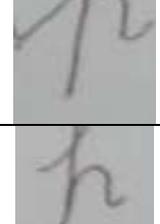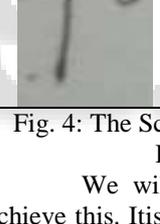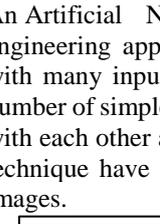
Fig. 4: The Scanned Patterns of Letter 'P' Representing Different Traits of the Writer

We will be using Artificial Neural Networks to achieve this. Itis a widely-used machine learning technique. An Artificial Neural Networks (ANN) is basically an engineering approach of biological neuron. It have device with many inputs and one output. ANN is consist of large number of simple processing elements that are interconnected with each other and layered also. Some computers using this technique have even out-performed humans in recognizing images.
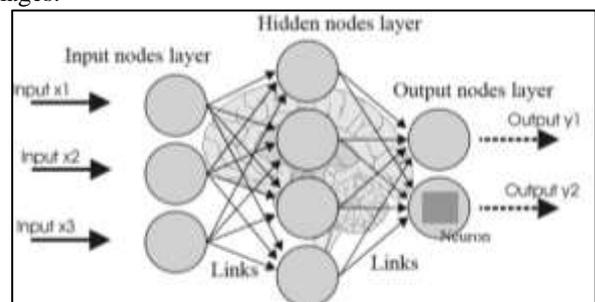

Fig. 5: The Structure of an Artificial Neural Network

The above shown image is an ANN which is look-alike or a simulation of human brain in which several neurons (in our human brain approximately 80 billion neurons are connected) are connected and transmit information to depict something and conclude results.

This algorithm will take the baseline, slant, word spacing, pen pressure along with the letter 's' and 'p' as inputs and will give out the characteristics of the person as output. The process is shown in the form of a simple block diagram as shown below:
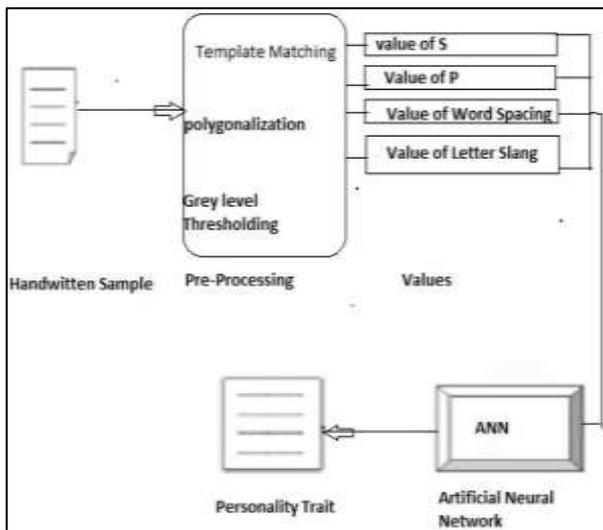

Fig. 6: A layout of the Working of our Model using ANN

III. Implementation & Result

This project work is divided in two parts:
a) Handwriting Recognition
b) Character Prediction

For Handwriting Recognition:
– Python was used because it easy to understand syntax and wide range of support
– It has a ton of excellent libraries with most of the code already written and we need to make very less changes to it. So we can focus more on predicting the personality traits rather than rewriting algorithms
– It is fast. Well this is a point that can be easily argued upon, by fast we mean that it can be used to do fast numerical calculations because it has Numpy and it also has support of scikit-learn which itself is a library of machine learning algorithms and OpenCV for image precessing.

A. *Examining Result*

We were able to achieve an acceptable accuracy in predicting the handwriting of the person.

B. *For Character Prediction*

Artificial Neural Networks is used to predict the personality traits of the people by giving in the classifier model an input of the baseline, slant height, pen-pressure, word spacing and the letters 's' and 'p' we were able to predict some characteristics of the user.

IV. Conclusion

A method has been proposed to predict the personality of a person from the features extracted from his handwriting using Artificial Neural Networks. The models takes in the baseline, letter slant, pen pressure, word spacing and the letters 's' and 'p' as input as predicts some personality traits of the person based on these properties. The evaluation of the baseline and slant is done using the polygonalization method, the difference between letters is calculated using thresholding the image region in Python using OpenCV and the evaluation of the pen pressure utilizes the grey-level threshold value. The letters 's' and 'p' are matched using template matching.

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